

REMARKS/ARGUMENTS**1. Drawings**

As noted above, Fig. 4 has been revised to include a depiction of the grounding of pin 13, per the objection made in the Office Action.

2. Specification

In the specification, paragraph [0018] has been amended to reference the branched bus (18') depicted in Fig. 2, and paragraph [0023] has been amended to reference the pins (21) depicted in Fig. 3. No new matter has been introduced.

Also per the objections in the Office Action, paragraph [0043] has been amended to eliminate the duplicate word, "been."

3. Claim Objections

Claims 1-10, 14, and 20 were objected to for informalities, and have all been appropriately amended. These amendments do not narrow the scope of the claims in any way, as the words added are superfluous.

4. Claim Rejections - Indefiniteness

Claims 7 and 10 were each rejected as indefinite for lack of antecedent basis for the term "the current." These claims have been amended to delete the article "the" preceding the noun "current," clarifying that the term was not previously recited. These amendments also do not narrow the scope of claims 7 or 10.

5. Claim Rejections - Prior Art

All claims but claim 18 stand rejected as anticipated by U.S. Patent No. 5,460,093 to Prinz et al. ("Prinz"). Claim 18 stands rejected as obvious over Prinz in combination with U.S. Patent No. 5,014,622 to Jullian.

Claim 11 has been canceled, and new claim 21 added. Also, claim 10 has been amended to add the limitation "to a constant current" following the term "wherein current to said firing energy storage module is limited."

The claims as presently pending therefore all include the limitation of a "constant current charging module" or the step of charging a firing energy storage module "wherein current to said firing energy storage module is limited to a constant current." As explained in paragraph 6 of the declaration of Gimtong Teowee submitted herewith, such a limitation is clearly not disclosed or suggested by Prinz:

Prinz discloses that arming circuit 54 merely employs a switch 58 to charge the firing capacitor 32, and therefore plainly describes a conventional non-constant-current charging process To achieve the constant-current charging of the present invention, circuitry far different from a simple *switch* would be required, such as the examples of a "current-mirror using two bipolar transistors or MOSFETs, a fixed gate-source voltage on a JFET or MOSFET, or a current feedback using an op amp or comparator" provided in paragraph 61 of this application. Prinz therefore fails to disclose or suggest constant-current charging

In response to the Office Action's assertion that Prinz inherently discloses constant-current charging because it is the fundamental method of charging a capacitor, paragraph 5 of Mr. Teowee's declaration explains that is not correct:

[T]he constant-current charging process ... is not the fundamental method of charging a capacitor; to the contrary, the fundamental and conventional method of charging a capacitor is by applying a fixed voltage across the terminals of the uncharged capacitor. When a fixed voltage is applied across the terminals of an uncharged capacitor, the current drawn by the capacitor starts out high and gradually reduces until the charged voltage is reached. Thus, the current drawn is not remotely a constant current as [claimed]

In addition to not being anticipated by Prinz, there was no motivation and it was not obvious to modify the pyrotechnic device taught by Prinz to incorporate a prior art constant-current charging circuit (e.g., from a laptop computer battery charger) and apply it to the firing energy storage device. As discovered by Applicant, the use of constant current charging of an igniter firing energy storage device results in benefits that would not have reasonably been foreseen except with hindsight based on knowledge of the invention itself. As explained in paragraph 7 of Mr. Teowee's declaration with reference to the example of an electronic blasting system (such as that of Prinz):

[A]dding the circuitry required to attain constant-current charging permits desirable reductions in sagging of the bus and potentially damaging surge to the firing capacitors, yet it does not introduce potentially unsafe conditions in order to do so (as can be the case with automatic charging up of firing capacitors upon powering up of the bus as in prior art). This solution was certainly not obvious at the time of the invention, and variations of it can also make possible a number of other advantages that would not have been anticipated. Such potential advantages are elucidated, for example, in paragraph 3 of this application discussing enhanced bus line monitoring and avoidance and/or reduction of malfunctions relating to shorted or defective capacitors and/or ignition elements, paragraphs 3 and 62 discussing simplified capacitor diagnostics, and paragraphs 59-60 regarding staggered charging of a potentially large number of detonators on the system.

Favorable action on this application is thus respectfully requested in view of the foregoing amendments and evidence.

Respectfully submitted,



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Attachments: Replacement & Annotated Drawing Sheets; Declaration